Essential Epidemiology and Laboratory Components of a State Foodborne Disease Prevention and Control Program

I. BACKGROUND

Foodborne illnesses are common, affecting millions of Americans every year. In many cases, foodborne illness can be life-threatening or lead to chronic conditions such as chronic kidney disease, arthritis or neurologic disease. Pathogens such as *Salmonella* (identified as foodborne in the late1800s) remain as difficult public health challenges, while new foodborne pathogens and toxins continue to be recognized. In recent years, the character of reported foodborne illness outbreaks also has changed dramatically: large-scale, multistate outbreaks involving interstate or international transport of contaminated food products are now being detected. The nation's public health system must be strengthened to assure rapid, well-coordinated response to outbreaks of foodborne illness.

In 1997, President Clinton launched the National Food Safety Initiative (NFSI) to reduce the incidence of foodborne illness to the greatest extent feasible. An essential component of this initiative is to strengthen the nation's capacity to detect and respond effectively and rapidly to outbreaks of foodborne illness. To do this, the Centers for Disease Control and Prevention (CDC) is working with other federal agencies and state and local government partners–the front lines of surveillance outbreak detection and response– to develop a national early warning system for foodborne illness. This will expand the nation's capacity to detect and respond to foodborne illness, improve characterization and understanding of the infections and factors leading to these illnesses, enhance the level of technology available to address foodborne illness, and link federal and state laboratories through a national network that will improve the ability to detect and communicate information on foodborne infections.

II. PURPOSE AND SCOPE OF THE REPORT

Outbreak response at the state and local levels is an integral component of an early warning system for foodborne illness. This report is in response to numerous state and local health department requests for CDC assistance in developing and strengthening their foodborne disease surveillance and outbreak investigation and response capability. CDC collaborated extensively with the Council of State and Territorial Epidemiologists (CSTE), the Association of Public Health Laboratories (APHL), other federal agencies, and representatives of state and local health departments in developing this report.

The purpose of this document is to summarize current expert opinion on what constitutes adequate epidemiology and laboratory capacity for surveillance and outbreak response at the state and local levels. It is intended to provide a benchmark for planning and developing epidemiology and public health laboratory programs. The report does not address the organization and management of state and local programs, as this will differ based on how public health is organized in each jurisdiction.

Protecting public health and assuring safe food involves numerous disciplines and requires collaboration and coordination among many government agencies and the private sector. This CDC report does not attempt to address all the components of an effective food safety program, such as environmental health and other food protection expertise. CDC encourages–and looks forward to working with–its federal, state, and local partners to develop additional benchmark reports to assist states and localities in building their food safety programs. Such reports will supplement and complement the guidance contained in this report intended for epidemiology and laboratory programs. CDC welcomes comments and suggestions for refining the concepts presented in this document, with a view toward updating the report over time.

III. STATE SURVEILLANCE AND OUTBREAK RESPONSE CAPACITY

There are three essential components to all foodborne illness surveillance and outbreak response: epidemiology, food protection, and laboratories. These components may all exist in one agency at any level of government, or multiple agencies may be involved in fulfilling these roles. Public health capacity is a function of the number of trained staff, the facilities and equipment, the information and financial resources available, and the manner in which they are organized and managed to effectively address food safety. This document is intended to provide guidance on the basic building blocks of food safety programs at the state and local level.

Every state health department should have sufficient epidemiologic, laboratory, and environmental health expertise to gather and evaluate clinical, demographic, environmental, and laboratory information on syndromes and infections that are potentially foodborne; to conduct epidemiologic, laboratory, and environmental investigations; to analyze and interpret data; to initiate appropriate disease prevention and control efforts; and subsequently, to evaluate their effectiveness.

A. *Epidemiologic surveillance capacity to identify sporadic and outbreak-related illnesses*

Core epidemiologic capacity for surveillance of foodborne diseases in every state requires the resources to perform the surveillance functions identified below (Table 1). Creation of an effective and efficient national database will require that uniform methods, definitions and procedures be established nationwide; however, the knowledge and skills to design and implement surveillance systems should be in every state.

Table 1. Core surveillance functions

Data collection	a) Obtain reports of positive tests for foodborne pathogens and conditions from clinical laboratories and health care providers. b) Design and implement a standard format to receive, record, and interpret citizen complaints of foodborne illness and hazardous situations.
Patient interviews	Follow up case reports of potentially foodborne illnesses to obtain further information on occupational risk, food history, other possible exposures and risk factors. a) Interview each person with reported infection within 2 weeks of diagnosis for *E. coli* O157:H7, hepatitis A virus, *Salmonella*, *Shigella*, *Listeria*, *Vibrio*, *Cryptosporidium*, and *Cyclospora* organisms. b) Review clusters of cases of infection detected by laboratory (e.g., serotyping or pulsed-field gel electrophoresis) and reinterview affected persons as appropriate.
Case management and consultation	Consult with local public health units, clinicians and public regarding cases of anything that is potentially foodborne, e.g. *Campylobacter*, hepatitis A, botulism, or any undiagnosed infections. Provide information/prevention message to each reported person with *Campylobacter, Salmonella, or Norwalk-like* virus. Identify and offer postexposure prophylaxis to close personal contacts of each person with reported hepatitis A.
Data management	Enter data in electronic databases; analyze and interpret data in a timely manner.
Data transmission	Transmit surveillance data electronically in a standardized format to other local, state, and national jurisdictions to allow detection of related cases crossing state and county lines. a) Transmit weekly surveillance data on notifiable foodborne diseases and foodborne outbreaks in progress. b) Transmit serotype-specific *Salmonella*, *Shigella* and *E. coli* O157:H7 data weekly.

B. *Capacity to investigate and respond to outbreaks*

A critical element of an effective program for foodborne disease prevention is the ability to rapidly detect, investigate and interrupt chains of transmission of foodborne illness. Responding to outbreaks of foodborne disease is primarily a local and state governmental responsibility. Local and state jurisdictions are often the first to suspect and detect increases in illness and initiate an investigation.

However, outbreak detection and investigation may include any of several agencies, emphasizing the need for coordination and increased resources and capabilities. Regional and national outbreaks that are low-level and diffuse are sometimes detected by CDC at the national level before they are suspected locally. Federal agencies, including HHS (CDC, FDA), USDA, and EPA, may participate in the investigation under certain circumstances.

In addition, the private sector may play an important role in an outbreak response, including initially detecting a problem or recalling implicated food products.

Epidemiologic investigations of foodborne disease outbreaks may differ according to the specific circumstances of the outbreak and the state's program, but several functions are essential for an effective response to be made. The state must have the ability to determine whether a cluster of cases does or does not constitute an outbreak and to evaluate whether further investigation is warranted. Once the decision has been made to initiate an outbreak investigation, a number of specific steps must be carried out promptly and effectively, and this will require epidemiologic, food protection and laboratory capacity in addition to the resource levels needed for core surveillance functions.

Table 2. Core outbreak response functions

Leadership and management	Organize investigation team and resources. Prepare for field work (e.g., administration, clearance, travel, contacts, designation of lead investigator). Notify other relevant jurisdictions.
Verification of diagnosis	Obtain medical history and do physical examination of acutely ill persons, as appropriate; collect and transport clinical samples to the laboratory to identify the causative agent.
Case ascertainment	Construct a working case definition; systematically identify additional cases.
Data collection	Develop and administer questionnaires; conduct interviews of case patients and controls, as appropriate.
Data management	Set up a database and enter data.
Descriptive epidemiology	Analyze cases by place, time and person.
Study design	Design an analytic study to test hypotheses.
Data analysis	Analyze data to identify the vehicle of transmission and determine how best to interrupt transmission.
Traceback	Identify the preparer, retailer, processor and farm of the implicated food or ingredients as appropriate.
Environmental investigation	Evaluate environmental conditions associated with production and transport of implicated food or ingredients; evaluate food preparation and processing practices.
Recommend and communicate prevention and control measures	Provide information on prevention and treatment to affected persons and the local medical care community; identify actions of preparer, retailer, processor and farmer to reduce risk; identify actions, if any, to be taken by regulatory agencies.
Summarize and report the outbreak	Summarize investigation for requesting authority Prepare written report(s) to CDC, to policy makers.

In addition, questions are often raised by outbreaks or other investigations that need to be answered by conducting an expanded local investigation. The expanded investigation is critical to designing, implementing or assessing a preventive intervention. Examples would include surveys of restaurant facilities, dairy farms, schools or nursing homes regarding a specific practice, food, or knowledge. The survey might involve laboratory sampling.

C. *Laboratory capacity to support surveillance, investigation, and outbreak response*

Public health laboratories at the city, county and state levels play critical roles in surveillance and investigation of foodborne and waterborne disease outbreaks. In conjunction with epidemiology partners, the state public health laboratory coordinates investigations with state and federal regulatory agencies and CDC as needed. Except for a few large cities (e.g., New York) and counties (e.g., Los Angeles County, California; King County, Washington) with public health laboratories, the state public health laboratory is the primary facility responsible for detection and characterization of infectious agents in support of epidemiologic investigations.

Every state public health laboratory must have the capacity and expertise to isolate, identify and type the enteric and non-enteric foodborne and waterborne pathogens. This requires competency in culture techniques, microscopy, serology, and toxicology/chemistry; familiarity with new molecular approaches; and access to electronic diagnostic aids, such as digitized reference slides and other digitized imagery available from CDC's Public Health Image Library and other CDC web sites. These capabilities are beyond what is routinely done in clinical and commercial diagnostic laboratories. For example, state public health laboratories should have the capability to perform the specialized enrichment and concentration procedures needed to isolate pathogenic microorganisms present in very low levels in foods. They must be able to carry out specialized resuscitation of sublethally stressed/injured pathogenic microorganisms from foods that have been subjected to processing conditions that are debilitating but not lethal to the microorganisms. Public health laboratories should have the capacity to isolate and identify pathogens such as the Norwalk agent or enterotoxigenic *E. coli*, which may not be a diagnostic priority for physicians treating individual patients or for food analysts, but nevertheless represent significant public health problems.

State public health laboratories act as next to last reference centers for definitive identification of pathogenic microorganisms. They are a repository for the classic methods of identification as well as a proving ground for technologically sophisticated molecular methods. State public health laboratories should have the capacity to characterize pathogenic microorganisms beyond what is done at the clinical or commercial diagnostic laboratories. Such characterizations often may not directly relate to the diagnosis of illness or treatment of individual patients but are critical for public health functions. Examples include determining the ability of pathogens to produce specific toxins or other virulence-associated factors and identifying specific toxin types, e.g., Shiga toxins, heat-labile and heat-stable toxins produced by enterotoxigenic *E. coli*, cholera toxin, staphylococcal enterotoxins, *Clostridium perfringens* enterotoxin, and diarrheal toxin of *Bacillus cereus*.

Recognizing and properly identifying major parasitic organisms associated with

foodborne outbreaks still require sufficient microscopic expertise to render a diagnosis. Each state should strive to maintain microscopic expertise to identify *Giardia*, *Cryptosporidium*, *Cyclospora* and other parasites. In addition, most state public health laboratories will want to maintain expertise in using commercially available EIA or FA kits for detection of *Giardia* and *Cryptosporidium*, not only because of the sensitivity and specificity afforded by these assays, but because of the large number of specimens that can rapidly be processed in an outbreak setting.

Within the next 5 to 10 years, identification and subtyping of pathogenic microorganisms will likely be based on DNA sequence-based tests. For some viral pathogens, such as hepatitis A virus, sequencing-based approaches are required for subtyping and characterizing strain. At least some state health departments will need to acquire and apply these technologies in order to support hepatitis A epidemiologic investigations. Certain state health departments could be designated as regional resources to acquire and begin applying DNA sequencing-based approaches to pathogen identification, characterization and subtyping.

State public health laboratories must have the capability to perform molecular subtyping of foodborne and waterborne pathogenic microorganisms in a timely manner to aid epidemiologic investigations. PulseNet, CDC's national molecular subtyping network for foodborne disease surveillance, has already demonstrated the utility of rapid routine subtyping of pathogenic bacteria by state health departments. State and city public health laboratories participating in PulseNet have supported outbreak investigations by helping to interpret the epidemiologic data, identify clusters of disease that would not have been otherwise identified, and link cases in distant locations with outbreaks occurring in a specific region in the country. For PulseNet to be fully successful, state public health laboratories must have adequate resources and capability to perform routine subtyping of foodborne pathogenic bacteria in a timely manner, analyze the data without delay, provide the subtyping data and interpretations to state epidemiologists, and send the DNA patterns to CDC (or upload the patterns to the PulseNet server located at CDC) so that they can be compared with the national database and shared with other PulseNet laboratories.

Every state health department should have the capacity to maintain adequate staffing levels, equipment, reagents (e.g., *Salmonella* antisera), and supplies to rapidly test for core foodborne and enteric pathogens in the context of an outbreak (Table 3). Laboratory staff should receive adequate training in a variety of routine and specialized diagnostic methods, including culture techniques, pulsed-field gel electrophoresis, and molecular subtyping of microbial agents. In addition to the core elements specified above for every state public health laboratory, protecting the American public from foodborne infections and intoxications requires that laboratories have access to testing for infectious agents that are rarely encountered (Table 4). Resources for identifying rare or hard-to-identify pathogens or for performing resource-intensive subtyping are not necessary in all laboratories, but they should be geographically dispersed so that infections in any part of the country can be diagnosed in a timely manner. Training should also be available to maintain a laboratory's proficiency to test for infectious agents that are rarely encountered. The sites providing services not included in the core capacity should have established written protocols for the tests they perform. During outbreaks, all states need clearly defined access to the services listed in Table 4.

Table 3. State laboratory capacities necessary for identification of pathogenic microorganisms

Pathogenic microorganism	Core identification capacity necessary for every state	Additional capacity needed in a regional reference center
Bacillus cereus	Confirm identification. Assess diarrheal toxin production by commercial immunologic tests.	Confirm ability to produce diarrheal toxin by DNA amplification tests.
Campylobacter jejuni and *E. coli*	Species identification. Subspecies identification by biochemical tests. Antimicrobial susceptibility testing for epidemiologic purposes.	Confirm species identification by molecular methods. Confirm subspecies identification by molecular methods.
Clostridium botulinum	Screen specimens for toxins by using commercial immunoassay kits (subject to availability of kits with acceptable sensitivity and specificity).	Detect toxin by mouse bioassay and amplified ELISA systems.
Clostridium perfringens	Identify species counts spore in stool; detect toxin in stools.	
Escherichia coli O157:H7	Confirm species identification; confirm the presence of O157 antigen; identify H7 antigen. Test isolates for Shiga toxin production or capacity to produce Shiga toxins. Antimicrobial susceptibility testing for epidemiologic purposes.	Determine the type of Shiga toxin(s) produced by clinical isolates.
Shiga toxin-producing *E. coli* other than *E. coli* O157:H7	Confirm species identification. Antimicrobial susceptibility testing for epidemiologic purposes.	Identify serotypes O157:H7, O111, and O26. Determine the type of Shiga toxin(s) produced by clinical isolates.

Enterotoxigenic *E. coli*	Confirm species identification. Determine production of heat-labile (LT) and heat-stable (ST) enterotoxins by commercial immunoassays (subject to availability of kits with acceptable sensitivity and specificity). Antimicrobial susceptibility testing for epidemiologic purposes	Determine LT and ST-producing capacity by DNA amplification tests.
Listeria monocytogenes	Identify to species level. Antimicrobial susceptibility testing for epidemiologic purposes	Identify atypical isolates by molecular methods. Identify most common serotypes.
Non-typhoidal *Salmonella*	Confirm identification as *Salmonella*. Perform biochemical characterization to subspecies level. Identify top 20 serotypes. Antimicrobial susceptibility testing for epidemiologic purposes. Identify multidrug-resistant *S*. Typhimurium	Identify 90% of *Salmonella* serotypes.
Shigella	Identify to species level. Antimicrobial susceptibility testing for epidemiologic purposes.	Identify serotypes.
Vibrio cholerae	Identify to species level. Identify O1 and O139 serotypes. Use commercial immunoassays to determine cholera toxin production (subject to availability of kits with acceptable sensitivity and specificity). Antimicrobial susceptibility testing for epidemiologic purposes	Use PCR to evaluate cholera toxin production.
Vibrio parahaemolyticus	Identify to species level.	Identify virulence factors.
Vibrio vulnificus	Confirm identification.	Perform DNA amplification test for cytolysin.

Yersinia enterocolitica	Confirm identification. Determine if isolate is potentially pathogenic by biochemical tests.	Perform additional tests for virulence factors. Identify serotypes O:3; O:5,27; O:8 and O:9.
Giardia *Crytosporidium* *Cyclospora*	Identify to species level.	
Hepatitis A	Confirm diagnosis by diagnostic serology	
Shiga toxin *Staphylococcus aureus* toxin	Confirm presence of toxin by chemical analysis	

Table 4. Special laboratory services

Parasite identification
Trichinella
Toxoplasma
Cysticercus
Microsporidia
Virus culture and identification
Caliciviruses (Norwalk and Norwalk-like viruses)
Chemical analyses
Histamine
Common shellfish toxins
Heavy metals
Other laboratory technologies
Pulsed-field gel electrophoresis analysis of *E. coli* O157:H7, *Listeria* and *Salmonella*
Polymerase chain reaction
Immunomagnetic separation

D. *Public health infrastructure necessary to support food safety*

The capacity of a state public health department program for foodborne disease prevention and control is a function of its infrastructure, i.e., the information and financial resources available and the manner in which these are organized and managed. At the state and local levels, foodborne disease surveillance and epidemiology are generally conducted within the context of general communicable disease control. Below are general guidelines for developing adequate public health infrastructure for the surveillance, investigation, and control of foodborne disease due to microbial contamination.

Staffing. The staffing levels discussed below are guidelines only. The appropriate number of epidemiologists, laboratorians, and support staff, and their educational/skill levels will be

determined by the size of the jurisdiction served and the anticipated magnitude and complexity of food safety issues to be addressed. However, every jurisdiction must possess the human resources necessary to conduct the core food safety functions (Table 5).

Table 5. Core staffing guidelines

Epidemiology	1 FTE doctoral-level epidemiologist for every 5,000,000 population 1 FTE masters-level epidemiologist per 1,000,000 population 1 FTE bachelors-level disease intervention specialist per 50,000 population
Laboratory	1 FTE doctoral-level microbiologist for every 10,000,000 population 1 FTE bachelors-level microbiologist per 500,000 population
Information management	1 FTE data manager per 5,000,000 population 1 clerical or data entry position per five technical/professional staff

For every 5,000,000 population, each state should have at least one full-time doctoral-level epidemiologist whose primary responsibility is foodborne disease. Ideally this should be a physician or other health professional with training and experience in diagnosis and treatment of human illnesses in general, and foodborne diseases in particular. In addition, every state should have at least one full-time masters-level epidemiologist per 1,000,000 population whose responsibility is foodborne disease. This should be a registered nurse, sanitarian, or other public health professional with background in human health and training and experience in conducting surveillance and epidemiologic investigation of communicable diseases in general, and foodborne disease in particular. Every state should also have one full-time bachelors-level foodborne disease intervention specialist per 50,000 population. This should be a registered nurse, sanitarian, or other public health professional with background in human health and training and experience in conducting patient interviews and investigation and case management of communicable diseases in general, and foodborne disease in particular.

A state public laboratory should have one full-time doctoral-level microbiologist for every 10,000,000 population. In addition, every state should have at least one full-time bachelors-level microbiologist per 500,000 population. In either the epidemiology or laboratory office, every state should have one full-time data manager per 5,000,000 population. Ideally, this person should be trained in epidemiology as well have good data management skills.

The number of support staff will vary depending on the degree of office automation and other factors. In general, adequate clerical staff to support the public health professional and technical staff will be about one clerical or data entry position per five technical/professional staff.

These staffing levels are guidelines only; the most appropriate staffing levels will match the skills and education of staff to the complexity of the tasks and technology, and the burden of illness being addressed. For those states whose local circumstance, population size, or

population distribution do not lend itself to readily adopting these guidelines, Table 6 provides estimates of work load for selected food safety functions. These estimates can be applied to local estimates of morbidity and mortality to determine the need for staff to accomplish the core activities for foodborne disease surveillance and outbreak investigation. Alternatively, estimates of disease incidence, outbreak frequency, and related events based on the FoodNet experience (Appendix I) can be used in lieu of better local data.

Table 6. Work load estimates for selected core functions

Function	Estimated staff time
Patient interviews	a) Two hours per patient interviewed. b) Target review and reinterview of case clusters detected by laboratory surveillance (e.g., serotyping or PulseNet) – two work days (16 hours) per cluster.
Case management and consultation	a) Patient information and education – ten minutes per case. b) Consultation with local health departments, clinicians, and public - one hour per consultation.
Laboratory confirmation & Subtyping	two hours per isolate.
Data entry and transmission Transmit weekly epidemiologic surveillance data on foodborne diseases and outbreaks	a) Two hours per week. b) Enter and transmit weekly laboratory surveillance data on *Salmonella, Shigella* and *E. coli* O157 via PHLIS - 15 minutes per transmission and 30 seconds per week. c) Summarize and report foodborne outbreak reports - four hours per outbreak report
Outbreak Investigation	a) Outbreak investigation - four person-weeks per outbreak investigation. b) Special Surveys - ten person-weeks per survey; c) Laboratory – ten person-weeks.
Traceback	Two person-weeks for traceback study
Environmental investigation	One person-week for restaurant follow-up and inspection.

Information and communications. Communication is critical for an effective outbreak response program. It must be rapid, correct and complete. Health departments must be prepared to respond to food safety emergencies at any time and must have the communication and information technology to support this response. States should have the capacity to communicate with agencies at the local, state, and national levels (including tribal units and military bases), the medical community, the public, and the media. Each of the professional/technical staff should have access to the Internet, electronic mail, and the World Wide Web, a desktop and a portable computer with modem, facsimile machine and paper, and mobile telephone.

In addition, a different type of communications network involving federal and state agencies and the private sector is required for surveillance. Surveillance for foodborne disease requires systems to collect and transmit data on individual diseases that may be foodborne as

well as on associated outbreaks. The architectural standards needed to ensure that state and local investments in information technology are compatible with the CDC Health Alert Network are available on the World Wide Web (http://www.bt.cdc.gov/Documents/IT/ArchStandards.wpd). Maintaining a smooth data sharing network to connect epidemiology and laboratory staff at the state level requires a LAN manager.

Education and training. In general, technical and professional staff should have at least 50 hours of continuing education and training per year to maintain requisite knowledge and skills. Changes in the nature of foodborne disease, methods for identifying pathogens, and computer and communication technologies have increased the importance of training and education programs for state and local public health workers. Cross-training staff so they can assist in large-scale investigations in ways that are not part of their normal job functions is one approach to producing surge capacity within constraints of available human resources. The state individual responsible for food borne diseases at the state level -- be it the state epidemiologist, the state laboratory director, the food program manager, or any other person given this responsibility -- needs to provide one week of training per 5 million population to local or regional epidemiology staff.

E. ***Regulations, authorities, and requirements***

Legal authority. Every state should have the necessary authority to identify and conduct epidemiologic, environmental and laboratory-based investigations of clusters of foodborne illnesses. The state health department should be able to require the submission of clinical and food isolates, specimens, and other laboratory samples needed for an adequate public health response to foodborne disease. Authority is also required to collect environmental specimens, to seize foods and ingredients, and to close establishments.

Alternatively, estimates of disease incidence, outbreak frequency, and related events based on the FoodNet experience

APPENDIX I

1. Surveillance functions

- **Patient interviews**

Estimated Incidence (per 100,000) of selected foodborne pathogens	
Salmonella	12.5
Shigella	8.5
E. coli O157	2.8
Listeria	0.5
Vibrio	0.3
Cryptosporidium	0.05
Campylobacter	21.7
(FoodNet 1998 data)	

- **Consultation with local health departments, clinicians, and public**

Estimated Incidence: Assume 25 calls per 100,000 population per year.

- **Dealing with potential clusters-**Target review and reinterview of clusters of persons with infection detected by serotyping or PulseNet.

Estimated Incidence of clusters: PulseNet analysis in Minnesota of 317 *E. coli* O157 isolates over 2 years found 35 clusters and 10 outbreaks, or 14 events per 100 isolates typed. (9 of the total involved 5 or more isolates, or 3 per 100 isolates.) (N. Engl. J. Med. 1997;337:388-394) Assuming the same rate for other pathogens, and assuming that PulseNet is applied to *E. coli* O157, *Salmonella* Typhimurium (25% of all *Salmonella*), *Shigella,* and *Listeria,* this equates to 16 isolates typed per 100,000, or 2.2 detected cluster events per 100,000.

- **Reporting and summarizing foodborne outbreaks.**

Estimated Incidence: 16 outbreaks per million per year

2. Foodborne outbreak investigation and coordination

We expect the number of detected outbreaks affecting 10 or more persons to double to 8 per million per year.

Estimated Incidence of Foodborne Outbreaks that are Investigated	
Affecting 10 or more persons	3.6 per million population/yr
Affecting 25 or more persons	1.6 per million population/yr
Affecting 50 or more persons	0.6 per million population/yr
(From FoodNet 1998 data)	

- **Sanitarian support of outbreak investigations**

D. Surveys

Estimated Incidence: 1 survey per year

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